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U.S. PROVISIONAL PATENT APPLICATION

for

VEHICLE COMPONENT AND METHOD FOR MAKING A VEHICLE COMPONENT

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FIELD

[0001] The present application relates to the field of molded articles having multiple colors and/or made from multiple materials. More specifically, the present invention relates to a molded article with multiple colors (or materials or textures) and integrated soft portions. More specifically, the present inventions further relate to interior panels or structures for vehicles (e.g., automobiles such as cars, trucks, and the like; airplanes, boats, etc.) or other applications that include at least one relatively soft (e.g., padded or cushioned) portion formed by a partial-mold-behind (PMB) process.

BACKGROUND

[0002] It is generally known to provide for a vehicle trim panel comprised of multiple colors or multiple materials by connecting multiple pieces. Such known trim panels are typically joined together into one assembly by conventional methods such as ultrasonically welding, heat staking or mechanical fastening. Another way of producing a multi-colored trim panel is to mask specific regions and paint the desired color.

[0003] However, such multi-piece trim panels have several disadvantages including poor fit and finish due to part and assembly variation.

[0004] Accordingly, it would be advantageous to provide a molded article that is molded with multiple colors, materials, textures, and the like. It would also be advantageous to provide a vehicle trim component (e.g., door panel, pillar, instrument panel, console, etc.) with multiple colors and/or multiple materials. It would further be advantageous to provide a multi-

color/multi-material trim panel that is molded as (one-piece) an article that does not need secondary joining operations and is not masked and painted. It would further be advantageous to provide a one-piece, multi-color/ multi-material panel that is aesthetically desirable and creates unique styling opportunities that would not normally be executed due to high cost and poor fit and finish outcomes associated with traditional methods. It would be desirable to provide for a trim panel having one or more of these or other advantageous features. To provide an inexpensive, reliable, and widely adaptable trim panel that avoids the above-referenced and other problems would represent a significant advance in the art.

[0005] It is also generally known to provide padded or cushioned vehicle interior components. Padded or cushioned vehicle interior components such as panels (e.g., instrument panels, door panels, etc.) conventionally include a substrate made of a relatively rigid material, a relatively soft core (e.g., a foam core), and an outer surface or skin. For example, a vehicle door panel may be cushioned to provide added comfort for an occupant of a vehicle when a portion of the occupant's body interfaces or contacts the door panel. Various methods of providing such cushioning are known in the art, although such known methods do not provide certain advantageous features and/or combination of features. For example, one difficulty in producing panels having cushioned portions is that it may be difficult to optimize the location of the cushioned portions such that the cushioned portions are provided only in areas that are directly interfaced (e.g., contacted) by an individual. Alternatively, certain areas of vehicle interior trim panels are not contacted by passengers such as locations on a door panel proximate the floor of the vehicle. There may be little or no reason to provide cushioned portions of the door panel in such regions. Further, providing cushioned portions or regions in areas where there is no requirement to do so adds unnecessary expense (i.e., material, labor, and equipment) and may also add excess weight to the vehicle.

[0006] To provide localized cushioned portions for interior vehicle components, one known method involves coupling a cushioned component to a rigid component. For example, a relatively rigid panel (e.g., a door panel) may have coupled thereto a component that includes a relatively rigid substrate, a relatively soft skin, and a foam interior portion. One difficulty with such a method is that such method requires the use of additional components (e.g., an additional substrate, bolts or other fastening devices to secure the panel substrate to the substrate of the cushioned portion, etc.), which adds both weight and expense to the finished product.

[0007] Accordingly, there is a need to provide a method for producing components such as panels or other structures for use in vehicles that includes a relatively soft portion or section. There is also a need to provide components that have regions of localized cushioning that are optimized based on the location likely to be interfaced by a vehicle occupant or other individual. There is also a need to provide a component that has regions of localized cushioning that has a decreased mass and requires less material than conventional components having cushioned regions. There is also a need to provide an integrally formed vehicle component that includes localized regions of cushioning. There is also a need to provide components and a method for making components that may be manufactured in a relatively simple and efficient manner with reduced manufacturing and material costs. There is also a need to provide a manufacturing method for producing components having one or more cushioned portions that utilizes existing equipment.

SUMMARY

[0008] One embodiment of the invention relates to a molded article comprising a multi injection substrate, and a coverstock or skin. The article is formed by a process wherein the

coverstock or skin is secured within the mold, a first material is injected into a first cavity; a retractor member is moved to define a second cavity, and a second material is injected into the second cavity. The first and second materials may be different types of plastic, different colors, or combinations thereof. The first cavity is defined by two mold sections (e.g., a cavity and a core) and the retractor member. The second cavity is also defined by the two mold sections, the retractor member, and the (at least partially) hardened first material. The first material may be configured to couple to the second material by a locking interface provided by recesses and/or projections on the mold sections.

[0009] Other embodiments further relates to various features and combinations of features shown and described in the disclosed embodiments.

DESCRIPTION OF THE FIGURES

[0010] FIGURES 1-34 illustrate a multi color or multi material processes according to preferred and exemplary embodiments.

[0011] FIGURE 35 is a perspective view of a door trim panel according to a preferred embodiment.

[0012] FIGURE 36 is a perspective sectional view of a door trim panel in FIGURE 35 taken along line 2-2.

[0013] FIGURES 37-40 are fragmentary perspective views of the door trim panel of FIGURE 36 in various states of fabrication.

[0014] FIGURES 41-46 are perspective views of an instrument panel and door according to preferred and exemplary embodiments.

[0015] Before explaining a number preferred, exemplary, and alternative embodiments of the invention in detail it is to be understood that the invention is not limited to the details of

construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or being practiced or carried out in various ways. It is also to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Referring to FIG. 1, a molded article (shown in FIGS. 1 and 2 as a door trim panel 10) is shown according to an exemplary embodiment. The trim panel 10 is manufactured (molded) from a process that allows for multiple colors and/or multiple materials to be allocated (positioned, located, molded, placed, etc.) at different portions of the trim panel. According to an exemplary embodiment, the process for making such a molded article includes multiple injections into a mold that is reconfigured during the molding operation, as further described below.

[0017] The advantages for this type of trim panel include the ability to localize and strategically place multiple colors and/or use of more premium materials that yield soft touch, low gloss, impact resistance, UV protection, high heat performance, or the like. For example, it is desirable to have soft touch or UV resistant additives on only the upper portion of a door panel or IP. Another advantage of this type of trim panel is the improvement of fit and finish because it is one-piece (as opposed to mechanically-joined multiple pieces) and produced in the same process.

[0018] There are many styling opportunities that can be realized with a multi-shot trim panel when compared to a conventional multiple-piece trim panel. The two-color color boundary may run (e.g., transition, pass, etc.) through an opening or another component. Isolated color break-ups that make a feature look separate may be realized in the one-piece trim

panel such as a different color molded-in speaker grille or map pocket border. Multi-color pillar trim may be provided to allow flow-through from the interior's front to rear without having to break the trim into multiple pieces. Accents in scuff plates and other trim may be produced in the same piece. Part separation does not have to dictate color break-up location. Specific details and features can be highlighted in a different color.

[0019] The method uses a multi-shot molding techniques (i.e. two-shot molding, spin molding, transfer molding, over molding, or the like) to produce a one-piece, multi-color/multi-material trim panel. The mold includes a core, a cavity, and a retractor. The first shot of plastic material (representative of a first portion 12 of trim panel 10) is constrained within the mold corresponding to a particular region on the trim panel by a retractor or slider mechanism. The retractor, core, and cavity provide a first cavity. Once the first cavity is filled with plastic, the retractor is displaced (preferably by approximately the thickness of the part). According to a preferred embodiment, the retractor is displaced to provide a second cavity (defined by the displaced retractor, cavity, core, and the first material). The second shot (representative of a second portion 14 of trim panel 10) then fills the second cavity and plastic flows to and bonds with the first material boundary. According to an exemplary embodiment, the second shot is provided by a secondary injection unit. The retractor provides the shut-off for the plastic by contacting the opposite side of the mold. According to a preferred embodiment, the first material is at least partially solidified when the second material is injected.

[0020] The surface on the retractor that contacts the opposite side of the mold can be perpendicular to or at an angle relative to the direction of the die (mold, tool, etc.) draw. According to an exemplary embodiment (shown in FIGS. 4, 12, and 13), the perpendicular retractor surface is configured to provide a "square" recess (e.g., ditch, indent, etc.) at the two-shot boundary.

[0021] According to another exemplary embodiment (shown in FIGS. 5-9), an angled shut-off (shown as surface 28 of a retractor 30) is configured to provide an angled recess 36 that is intended to allow the two-shot boundary to be hidden from the occupant's sight for most in-car positions. This angled shut-off 28 creates an apparent geometric gap or transition that may be more desired (for some molded articles) than a square, mechanical recess because it can hide the material joint.

[0022] Referring to FIGS. 10-12, to improve the strength of the two-shot boundary, an interlocking geometry can be created to provide a mechanical lock in addition to the chemical bond that exists. According to a preferred embodiment, the molded article includes interlocking geometries and an angled shut-off.

[0023] The shut-off surface on the retractor (either perpendicular to or at an angle to die draw) is designed to withstand molding pressures and prevent injected plastic from flowing into other areas of the tool. FIGS. 4-9 illustrate exemplary cross sections of square and angled two-shot boundary recesses or ditches that could be applied to a molded article (such as a trim panel, instrument panel, etc.). For example, trim panel 10 includes a first portion comprising a first color and a second portion comprising a second color. Portions of the trim panel is manufactured using a mold that is reconfigured during the molding operation during a process with shut-off stages so that plastic resin of different colors is injected into the mold at different times.

[0024] FIG. 3 illustrates another exemplary molded article (shown as a portion of an instrument panel 16). The instrument panel 16 includes an upper portion 18 molded with a first color and a lower portion 20 molded with a second color.

[0025] FIG. 4 shows a fragmentary sectional view of a mold during a molding operation for an instrument panel. According to an exemplary embodiment, the mold includes a

cavity 22, a core 24, and a slide or retractor 26. Preferably, the retractor 26 is at least partially disposed in the core 24. Preferably, the "A" surface (or "show surface") of the molded article is provided by the cavity 22 and the "B" surface is provided by core 24. According to alternative embodiments, the retractor is disposed in the cavity and/or the "A" surface is provided by the core.

[0026] According to an exemplary embodiment, the retractor 26 is configured to move between a first position and a second position (shown in broken lines) during the molding operation. (According to alternative embodiments, the retractor is configured to move to three or more positions (e.g., a third position, etc.) during the molding operation.) The slide or retractor 26 may be moved using any number of methods, including a spring-loaded and wedge system (so that when the mold sections open, the slide moves back into one of the mold sections), by hydraulics, pneumatics, mechanically, or the like.

[0027] The mold shown in FIG. 4 includes a vent 28 between the retractor 26 and the cavity 22. According to an alternative embodiment, the retractor may be designed to "shut-off" against the cavity (i.e., no vent). According to yet another alternative embodiment, the lower portion 20 of the molded article (instrument panel) may be molded first (e.g., by rotating the retractor around, for the geometry shown).

[0028] FIGURES 5-6 illustrate movement of a retractor 30 to provide for the first cavity and then the second cavity during the molding operation. Referring to FIG. 5, for the first shot 30 (shown in red), the retractor 30 closes-off on the cavity-half of the mold to prevent the first shot from entering into upper portion of tool (shown as the second cavity). The first shot is injected into the first cavity.

[0029] Referring to FIG. 6, for the second shot 34 (shown in blue), the retractor 30 is pulled back to open the upper portion of the tool and provide the second cavity. Preferably, the

retractor 30 moves approximately a wall-stock thickness. The second shot is injected and stops flowing when it reaches the first material. FIG. 6 illustrates the finished part.

[0030] Referring to FIGS. 8 and 9, examples of shut-off geometries are illustrated. The shut-off geometry allows the intersection or interface of the two materials (injections or "shots") to be hidden from view. According to an exemplary embodiment, the shut-off geometry provides for a recess 36 that has outer surfaces that are angled relative to the major surface of the molded part. According to a preferred embodiment, the recess 36 is angled so that interface of the two materials is hidden (e.g., at least partially, substantially, etc.) from the line of site of the vehicle occupants. According to an exemplary embodiment, the angled recess geometry is provided by an angled shut-off surface. Referring to FIG. 9, an arrow 38 illustrates the direction of the draw of the retractor and the mold die.

[0031] FIG. 12 is a fragmentary side section view of the mold configured to provide a molded article with a mechanical interlock 40. According to an exemplary embodiment, the mechanical interlock 40 is provided by one or more (or a series of) projections and/or recesses on the retractor. FIG. 10 illustrates a section of a square mechanical interlock 42 wherein the projections and/or recesses on the retractor have a square cross-section. FIG. 11 illustrates a section of a dovetail mechanical interlock 44 wherein the projections and/or recesses on the retractor have angled sides (e.g., to provide additional interlock, directional stability). The first shot 46 is shown in blue and the second shot 48 is shown in yellow. As such, the locking direction is vertical.

[0032] FIG. 13 is a side section view of a vehicle instrument panel 50 with a square recess 52 separating an upper portion 54 and a lower portion. The lower portion of the instrument panel 50 includes a glove box section 56 (which defines the rear wall of a glove box) and an outboard section 58 (which typically provides a generally flush surface with the glove

box door (not shown)). According to an exemplary embodiment, the upper portion 54 of the instrument panel 50 is molded first and then the lower portion of the instrument panel 50 is molded.

[0033] FIGS. 14-20 illustrate a retractor concept for allowing vertical walls (parallel to die draw) to be full material thickness according to an exemplary embodiment.

[0034] FIGS. 21-28 illustrate a retractor system for allowing vertical walls (parallel to die draw) to be full material thickness (e.g., for use in forming at corners). FIGS. 21 and 22 are a horizontal section of the mold having a core 60, a cavity 62, a first retractor 64, a second retractor 66 and a secondary slide 68. (Secondary slide 68 is configured to provide molded in detail for this particular molded article (i.e., recesses to receive an end cap for an instrument panel)). FIGS. 23-28 are vertical section views of the mold and the molded article (as it is molded). FIGS. 23, 25, and 27 are vertical sections of the mold when the first portion (blue) of the molded article is injected with a first material. FIGS. 24, 26, and 28 are vertical sections of the mold when the second portion (yellow) of the molded article is injected with a second material. As shown, use of the second retractor 66 is used to provide additional wall thickness.

[0035] FIGS. 29 and 30 illustrate a retractor system for allowing vertical walls (parallel to die draw) to be full material thickness. A mold for a molded article includes a first retractor or slide 70 and a second retractor or slide 72. The first slide 70 moves generally perpendicular relative to the major portion of the molded article. The second slide 72 moves generally angular (diagonal) relative to the major portion of the molded article. The molded article includes a first portion 74 made from the first injection (or "shot") and a second portion 76 made from the second injection (or "shot"). The mold shown in FIGS. 29 and 30 is different than the mold shown in FIGS. 21 and 22 in that the core portion between the first slide 70 and the second

slide 72 has been eliminated and the two slides are shaped so that the movement of the two slides 70, 72 provide for the cavity space to receive the plastic resin injections.

[0036] FIGS. 31-34 illustrate alternative styling embodiments using the disclosed method. For example, FIG. 32 illustrates several colors in one part, such as two-tone door look and separately-colored sail panels. Separate parts (e.g., soft-skinned area) can bridge two colors without fit issues. Also, isolated color break-ups (e.g., molded-in speaker griller made to look separate, and map pocket surround) may be used.

[0037] FIG. 33 illustrates part separation requirements that need not dictate color break-up location, which would be useful on quarter trim and B-pillar trim of a vehicle. Smaller details that would create fit or masking problems could also be achieved. Small details like cargo hooks or tie-down hook highlights can be molded-in.

[0038] The compressible material may be coupled to the skin and positioning the skin and compressible material in a mold; and forming a rigid substrate around the skin and compressible material providing a first soft region wherein the compressible material is disposed between the skin and the substrate so that a first soft region is defined by the compressible material. The substrate may comprises a molded polymer material such as a thermoplastic. The skin may comprise a thermoplastic olefin and be formed by vacuum forming and trimming a sheet. The compressible material may comprise a foam material such as a closed cell foam. The may comprise flanges so that the substrate can be molded to at least partially encapsulate the flanges. A second soft region may be defined by a portion of the skin in direct contact with the substrate (e.g., the compressible material is not disposed between the skin and the substrate).

[0039] FIGURES 35 and 36 illustrate one exemplary embodiment of a component or assembly such as a panel or other structure for use in a vehicle (e.g., automobiles such as cars,

trucks, buses, and the like; airplanes, boats, etc.). Such components may be provided in a wide variety of sizes, shapes, and configurations according to various exemplary embodiments. For example, such components may be utilized in an interior passenger compartment of a vehicle, and may find utility in the form of door panels, dashboards, instrument panels, consoles, sidewall trim, overhead liners, or other vehicle components or portions thereof. FIGURE 35 shows one exemplary embodiment of a door panel 110.

[0040] The vehicle component is provided with one or more localized or discrete areas or portion 12 of softness or cushioning in areas that are interfaced by a passenger or other individual. For example, door panel 110 such as that shown in FIGURE 35 may be provided with cushioning in areas 112 where a portion of a passenger's body are likely to contact the door (e.g., on an armrest 114, adjacent a window 116 sill, etc.) without the need to provide cushioning in the entire door (e.g., see FIGURE 35 in which regions 118 of hard plastic are shown in areas not typically contacted by a passenger). In this manner, the areas 112 of cushioning may be optimized based on the typical passenger experience. One advantageous feature of such method is that materials and manufacturing costs may be reduced, and the relatively inefficient practice of providing cushioning in areas that are not generally contacted by a passenger (e.g., beneath the armrest 114, etc.) may be eliminated.

[0041] The methods of providing localized regions 112 of softness or cushioning in a manner described herein may be utilized to provide components having a wide variety of configurations. For example, the door panel 110 may be provided that includes one or more portion 118 (e.g., areas, regions, etc.) islands of hard plastic (e.g., bezels, accents, appliqués, pull cups, etc.). In another example, complex geometries (e.g., ball armrests, x, y, z boundaries, etc.) may be formed. In yet another example, the door panel 110 may include proud (e.g., raised) or recessed regions of cushioning for enhanced aesthetics.

[0042] According to an exemplary embodiment, the component includes a member or element in the form of a relatively rigid substrate, base, or stratum (referred to herein as a "substrate" 120 for simplicity). A cushioned or padded portion or region 112 is located adjacent or proximate to at least a portion of the substrate 120, and includes a skin 122 and a filler material 124 provided intermediate or between the skin 122 and the substrate 120. It should be noted that according to various exemplary embodiments, all or a part of the substrate 120 may have a cushioned or padded portion 112 provided adjacent thereto. For example, according to an exemplary embodiment, the skin 122 is applied adjacent the substrate 120, and portions of the skin 122 may be in direct contact with the substrate 120, while other portions of the skin 122 may be separated from the substrate by the filler material 124. In this manner, selectively varying amounts or degrees of softness or cushioning are provided at one or more localized regions while retaining the look and feel of the skin even in those regions not provided with the additional cushioning of the filler material 124.

[0043] According to an exemplary embodiment, the relatively cushioned or padded member or element or portion 112 is disposed above or over at least a portion of the substrate 120. The skin 122 forms at least a portion of the exterior surface (e.g., the portion visible from a passenger compartment, which is typically be referred to as the "A" surface, etc.) of the component. According to an exemplary embodiment, a portion 126 of the substrate 120 forms a portion of the exterior surface. A boundary 128 between the substrate and the skin may be provided (e.g., in the form of a seam, interface or joint). Such boundary 128 may be visible at the exterior surface or may be filled in with a material to provide a "seamless" look for the component.

[0044] According to an exemplary embodiment, the skin 122 is made of a relatively soft or flexible material comprising a polymeric material (e.g., a thermoplastic olefin (TPO),

polyurethane, polyvinylchloride (PVC), etc.). According to other exemplary embodiments, the skin 122 may be made of other materials, including textiles such as cloth, leather, composite materials, layered materials (e.g., a layer of leather applied above a polymeric material layer), etc.

[0045] According to a preferred embodiment, the skin 122 is provided on the substrate 122 in such a manner that the filler material 124 (if any) is located intermediate or between at least a portion of the skin 122 and the substrate 120. According to an exemplary embodiment, portions of the skin 122 may be provided in direct contact with the substrate 120, such that filler material(s) 124 are located between the skin 122 and the substrate 120 in one or more particular regions. The particular design chosen may depend on any of a variety of factors, including the desired look and feel of the outer surface of the panel, materials costs, ease of manufacturing, etc.

[0046] According to exemplary embodiments, the skin 122 may be manufactured or produced utilizing any of a variety of process. According to a preferred embodiment, the skin 122 (e.g., a TPO sheet) is thermo formed (e.g., vacuum formed, pressure formed, etc.) and then trimmed to a desired shape or configuration.. In a vacuum molding process, a pre-cut or formed sheet of polymeric material is provided in a mold and heated to soften the material. A vacuum is applied to the mold, which draws the softened polymeric material toward the walls of the mold. The polymeric material then cools and maintains the shape defined by the mold walls. The formed sheet may also be trimmed for desired size.

[0047] According to an alternative embodiment, the skin is formed by a slush molding process (e.g., thermoplastic material in a liquid or powdered form is introduced into a temperature-controlled mold to form a viscous skin adjacent to the mold walls; once the skin is formed, the excess material is removed from the mold and the skin is allowed to cure and cool,

after which the skin is removed from the mold). According to other alternative embodiments, the skin 122 may be manufactured according to various other methods. For example, the skin may be formed in an injection molding process, an extrusion process, a casting process (e.g., gravity casting), or any other suitable process for forming a polymeric skin.

[0048] According to an exemplary embodiment in which the skin 122 is made of a polymeric material, the skin has a thickness of between approximately 0.1 and 2.0 millimeters, and most preferably between approximately 0.8 and 1.0 millimeters.

[0049] The skin 122 may have a size, shape, and configuration that is adapted or configured to features included in the substrate 120. The size, shape, and configuration of the skin 122 and substrate 120 may have any number of forms, and relatively complex geometries may be formed.

[0050] A material (e.g., the filler material 124) is coupled (e.g., bonded, fused, adhered, fastened, attached, etc.) to the skin 122 and located in between the skin 122 and the substrate 124 to act as a filler. It is intended that such material acts as a relatively soft or cushioning material to provide the cushioned member with at least a portion of its relatively soft or cushioned characteristic. According to a preferred embodiment, the material is a polymeric material such as a foam material (e.g., a urethane foam closed cell foam, on open celled foam, etc.).

[0051] The substrate 120 may be made of any suitable material, including any of a variety of polymers (e.g., polypropylene, polyethylene, copolymers, etc.). The substrate 120 may be formed in any of a wide variety of shapes, sizes, and configurations (see, e.g., FIGURE 35, which shows the door panel 110 according to an exemplary embodiment having regions of localized cushioning), and may include a variety of other features (e.g., apertures for door locks and handles, molded-in designs, etc.). The substrate 120 may be a stand-alone component or

may be a component in a larger assembly (e.g., the substrate may be an entire door panel or may be a portion thereof, etc.).

[0052] As shown in FIGURE 35, a visual boundary (e.g., a seam or joint) is formed or provided between the skin 122 and the substrate 120, such that the substrate 120 forms a frame around the skin 122. The size, shape, and configuration of the boundary may vary in various exemplary embodiments. The boundary may also be eliminated or reduced in size using a material to at least partially fill in the boundary (e.g., a caulk, adhesive, liquid polymer, or other materials). According to other embodiments, the skin 122 and substrate 120 may be provided in such a manner to minimize the visual boundary. FIGURE 5 illustrate one exemplary embodiment showing the coupling between the skin and the substrate.

[0053] Any of a variety of configurations may be utilized for the interface of the edges of the skin and the substrate. According to an exemplary embodiment, a flange 130 is formed on the skin 122 by forming the vacuum mold (e.g., to provide an edge of the skin with a "folded back" configuration to form a protrusion). The substrate 120 is then molded around the flanges 130 of the skin 122. According to a preferred embodiment, the skin 122 and substrate 120 are coupled together such that a relatively airtight and/or watertight seal is provided. In one example, the skin includes flanges 130 that extends substantially entirely about the periphery of the skin 122 and the substrate 120 is molded around the flanges 130 (e.g., to form a channel or groove that extends substantially entirely about the periphery of the area over which the skin 122 is provided and receive the flanges 30). Various sizes, shapes, and configurations may be used for the protrusion or flanges and the opening or groove to couple the skin 122 to the substrate 120.

[0054] According to an exemplary embodiment a door is shown with an integrated bolster and armrest. This invention utilizes a die-cut, compressible filler material 124, such as a

die-cut closed cell foam attached (via pressure sensitive adhesives or like processes) to the vac-form skin 122. The part is then placed into a tool and plastic is molded around the assembly to form the substrate 120. Where the compressible filler material 124 (and the skin 122) is present, there is a soft compressible feel to the part. Where there is no compressible filler material 124 behind the skin 122, there is a harder feel to the part. Using this innovative process, door trim panels may be manufactured having multiple colors or textures or softness portions.

[0055] According to an exemplary embodiment, a method of forming a panel comprises forming a flexible skin 122; coupling a compressible material 124 to the skin 122; positioning the skin 122 and compressible material 124 in a mold; and forming a rigid substrate 120 around the skin 122 and compressible material 124 providing a first soft region 112 wherein the compressible material 124 is disposed between the skin 122 and the substrate 120 so that a first soft region 112 is defined by the compressible material 124. The substrate 124 may comprise a molded polymer material. The skin 122 may be formed by vacuum forming and trimming a sheet. The sheet may be thermoplastic olefin. The compressible material 124 may be a foam material, such as a closed cell foam. The foam may be bonded to the skin 122. The skin 122 may comprise a flange 130 and the substrate 120 may be molded to at least partially encapsulate the flange 130. The panel may be a vehicle door trim panel 110. The skin 122 may be first formed, then the compressive material 124 is coupled to the skin 122, then the substrate 20 is molded to the skin 122 and foam 124. A second soft region may be defined by a portion of the skin 122 in direct contact with the substrate 120. The step of forming the substrate 120 comprises injection molding a plastic material.

[0056] FIGURES 41-46 are perspective views of a vehicle instrument panel and door according to preferred and exemplary embodiments. Referring to FIGURES 41-46, an

instrument panel and door are shown according to a preferred and exemplary embodiments, which show the integration of a two color in one tool injection molded substrate (FIGURES 1-34) with the addition of partial mold behind soft covering layer or cover stock (FIGURES 35-40). Integration of a two color substrate in one tool injection molded substrate with the addition of partial mold behind (PMB) soft skin in intended to reduce manufacturing costs, and increase flexibility (e.g., design and manufacturing) and craftsmanship (e.g., less "fitted" components, fasteners, additional manufacturing steps that may reduce quality). The process is inteneded to be flexible in that the laminate or substrate can be a wide variety of materials, colors, and textures. Also the colors of the injection molded substrate can also be varied without change to the tool. The material injected behind the substrate can also be translucent in nature, allowing for LED or conventional lamps (or any of a variety of light sources) to be located or attached to the rear of the panel to backlight the exposed rim of material (see FIGURES 44 and 45). In addition, this process eliminates assembly of various components that can lead to unsightly gaps, buzz squeak and rattle, and other craftsmanship issues.

[0057] In contrast, traditional methods of trim manufacture would require multiple tools to create the separate hard colors for the substrate and a separate tool to create the bolster with the laminate. Once these pieces are created, there would be an assembly process for joining of the three separate substrates requiring additional capitol, labor, and manufacturing footprint. The disclosed invention combines all of these into one injection molded tool. The substrate would be placed into the tool and the tool would close. The first color would be injected behind the laminate and would form a trim ring around the edge of the laminate on the a-side of the part. The second color would then be injected into the tool and would join to the first color. The part would exit the molding machine complete with the ancillary components to be added later. This vastly reduces the molding, capitol, and assembly costs for trim manufacture.

[0058] According to an exemplary embodiment, the process of forming the integrated molded article having one or more areas of non-rigid or soft areas is provided in a single mold or tool. A cover stock or skin (which may be a pre-formed three dimensional shape, a flat sheet, or the like) is loaded into the mold and located in the first cavity (i.e., one of the color or material regions). The cover stock may be any of a variety of materials, including but not limited to cloth with a foam backing, PVC with a foam backing, TPO with a foam backing, appliqué material (such as wood metal, etc.) a foil, a cloth without foam, a vinyl without foam, or the like. The cover stock is held or secured in its location by any of a variety of means (e.g., by its pre-formed shape conforming to the mold, pins, vacuum assist, etc.) The mold is then partially closed in preparation of a low pressure molding operation. The amount of gap provided by the partially closed mold will vary depending on the type of cover stock being used. (According to an alternative embodiment, the mold is closed entirely.) The molten plastic for the first substrate portion (e.g., the first color) is then injected or shot behind the cover stock. The mold is then closed completely as the plastic is being injected. The injection of the plastic and closing of the mold is configured to press the cover stock against the mold. After the injection of the first material is complete, the retractor is then moved or withdrawn from the mold cavity and the second material (e.g., a different color, a different material, etc.) is then injected into the secondary cavity. The mold is then opened and the finished part is removed. Preferrably, the substrate portion with the coverstock is molded first so that the mold is not opened during the operation cycle, though this would be an alterative. The amount of gap left in the partially closed mold will depend on a variety of factors, including the type of cover stock being used, geometry of the part, and the like. According to an alternative embodiment, the first and second materials are the same color and material and the retractor is not used such that both the primary cavity and the secondary cavity are filled at the same time. The process of integrating

the multi color of material substrate with the partial mold behind is intended to lower the cost and eliminate the footprint, assembly, capital investment, and increased craftsmanship. The material used for the substrate may be any of a variety of polymers, including but not limited to polypropylene, TPO, filled plastics, polycarbonate ABS blends, ABS, or any of a variety of other materials. For example, different "materials" used in the disclosed method may be different colors of the same plastic resin, configured to provide different textures; and the like. Also, different materials may be different plastic resins of the same or different color. Also, the disclosed process may be used on any of a variety of molded plastic articles, including vehicle components.

[0059] It is also important to note that the construction and arrangement of the elements of the vehicle trim panel as shown in the preferred and other exemplary embodiments are illustrative only. Although only a few embodiments of the present invention have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. Accordingly, all such modifications are intended to be included within the scope of the present invention as defined in the appended claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. In the claims, any means-plus-function clause is intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Other substitutions, modifications, changes and/or omissions may be made in the design, operating conditions and

arrangement of the preferred and other exemplary embodiments without departing from the spirit of the present invention as expressed in the appended claims.